EFFECTS OF A HIGH DENSITY OF BLACKLIGHT TRAPS ON CORN EARWORM POPULATION IN CORN

Production Research Report No. 127

Agricultural Research Service
UNITED STATES DEPARTMENT OF AGRICULTURE
In Cooperation With
Texas Agricultural Experiment Station

Acknowledgments

We wish to thank Ing. K. E. Merrem and Jorge Higuerra, Directors of Escuela Granja para Menores during our studies, and their staff, including Raul Lerma, for their cooperation and assistance in installing and maintaining the traps and other equipment and for making collections of the insects. Without their help it would have been impossible to carry out this study. We also acknowledge the assistance and cooperation of the Secretariats of the Governor, Agriculture, and Justice of the State of Tamaulipas, and the Plant Protection Division, U.S. Department of Agriculture. This work was carried out with the permission and cooperation of the Sanidad Vegetal, Secretaria de Agricultura y Ganaderia, Dario Arrieta M., Director General, and Instituto Nacional de Investigaciónes Agrícolos, Secretaria de Agricultura y Ganaderia, Nicolas Sanchez D., Director General.

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Contents

Washington, D.C. Issued April 1971

For sale by the Superintendent of Documents, U.S. Government Printing Office
Washington, D.C. 20402 — Price 20 cents

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The use of light traps to control lepidopterous pest insects has been frequently suggested. Among the insects for which this control method has been investigated is the corn earworm or bollworm (*Heliothis zea* (Boddie)). Noble et al. (*4*)[1] studied an installation of 142 light traps covering 3,000 acres in southern Texas and reported no control of the bollworm or the cabbage looper (*Trichoplusia ni* (Hübner)).

Lawson et al. (*3*), summarizing studies in an area 12 miles in diameter in North Carolina with three blacklight traps per square mile, reported striking reductions in hornworm (*Manduca* spp.) populations in the tobacco-growing area. They found small reductions in the number of corn ears damaged by the corn earworm in the trapped zone as compared with outside areas.

Sparks (*5*) evaluated the effects of light traps on 16,000 out of 46,000 acres of cotton in the Pecos, Tex., area for control of the bollworm and the tobacco budworm (*Heliothis virescens* (F.)). He failed to find any effect of trapping on infestations of these insects on a field-to-field basis, but he stated there was probably some impact on the total *Heliothis* population in the area.

The purpose of our study was to determine what effect a rather dense installation of blacklight traps might have on corn earworm populations in a semi-isolated cornfield.

Study Site and General Procedures

The study site was an irrigated field of about 49 acres at the Escuela Granja para Menores near Güémez, Tamaulipas, Mexico, about 20 miles northeast of Ciudad Victoria. This site was about

[1] Italic numbers in parentheses refer to Literature Cited, p. 24.

3 miles southwest of the nearest irrigated cropland, the Güémez Ejido, which contained several fields totaling about 148 acres.

Most of the land in the Ejido was planted in the spring and fall to corn with some beans and squash. Some small plantings of corn and vegetables were made on unirrigated land immediately adjacent to the study site depending on rainfall conditions. Other irrigated areas in the vicinity included pasture and fodder-sorghum fields 5 miles northeast and 1 mile southwest and a corn, bean, and squash area 11 miles southwest. The uncultivated area surrounding the study site was brushland and contained some potential *Heliothis* host plants such as *Abutilon* and other malvaceous plants and a wild tobacco, *Nicotiana repanda* Willd., when sufficient moisture occurred.

A semipermanent installation of 79 Gardner 15-watt blacklight traps was made in the study field. The Gardner trap, described by Sparks et al. (*6*) and shown in figure 1, was equipped with a fan,

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FIGURE 1.—Gardner light traps.

which blows insects attracted to the light into a ⅛-inch mesh hardware cloth basket. The traps were mounted on posts with the top of the funnel 7 feet above the ground or about the height of the tallest corn plants. The traps were located on the northwest side of the posts to provide some measure of protection from the prevailing southeast winds since Hollingsworth et al. (*2*) indicated light-trap efficiency was increased by windbreaks. The traps were placed at intervals of about 200 feet through the cultivated area.

The study included corn crops planted in the spring of 1966 and the spring and fall of 1967. Another crop was planted in the fall of 1966 but was killed by frost before fruiting. While the light traps were in operation, insects in index traps selected among the Gardner traps were normally collected daily by personnel of the Escuela Granja to provide an estimate of the number of earworm moths removed from the population. The index traps ranged from 10 in the spring of 1966 to 30 in the fall of 1967.

The insects in the collection baskets of these traps were sprayed with an aerosol of naled and lindane. After knockdown, collections from each trap were put into individual paper bags and stored in a refrigerator. Collections in the other Gardner traps were sprayed and discarded when the baskets became almost full. The collections from the index traps were taken weekly to the Brownsville, Tex., laboratory and examined. Female earworm moths were preserved in 70 percent ethanol for later dissection to determine the condition of the fat body and reproductive system by a method similar to one used by Callahan (*1*).

Periodic samples were taken to estimate the number of eggs, larvae, and infested ears in the field. These samples consisted of whole plant examinations on 20 row-feet at several locations in the field.

1966 Spring Crop

Procedures

Since no crop was planted in the study field in the fall of 1965 and host plants were very limited, overwintering populations within the field to infest the spring crop were minimal.

Five survey-type light traps (fig. 2) were operated in the field starting on January 5 at the locations indicated in figure 3, and insects were collected from them daily. These traps were a gravity type without fans and were equipped with solid-wall collection containers in which ethyl acetate was used to kill the insects as they were trapped.

Corn was planted in the study field in late February and the Gardner traps were put into operation on March 3 when the corn was 2 to 4 inches tall. Insects were collected daily from 10 Gardner index traps at locations shown in figure 3 as well as from the survey traps. The four peripheral survey traps were removed from the field one night weekly and operated at locations in the surrounding countryside starting on March 2. The center survey trap remained in operation in the study field at this time.

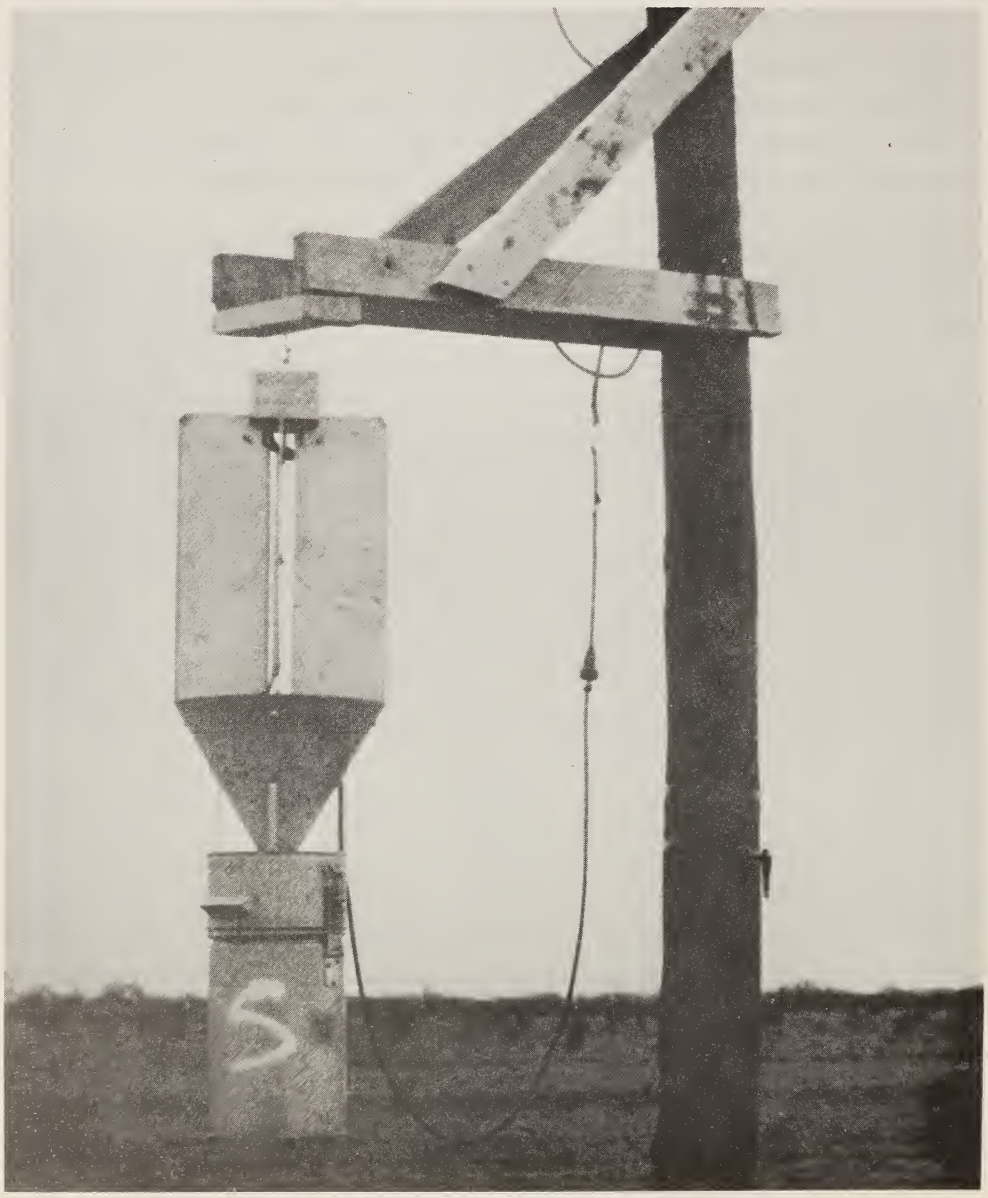

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FIGURE 2.—Survey trap.

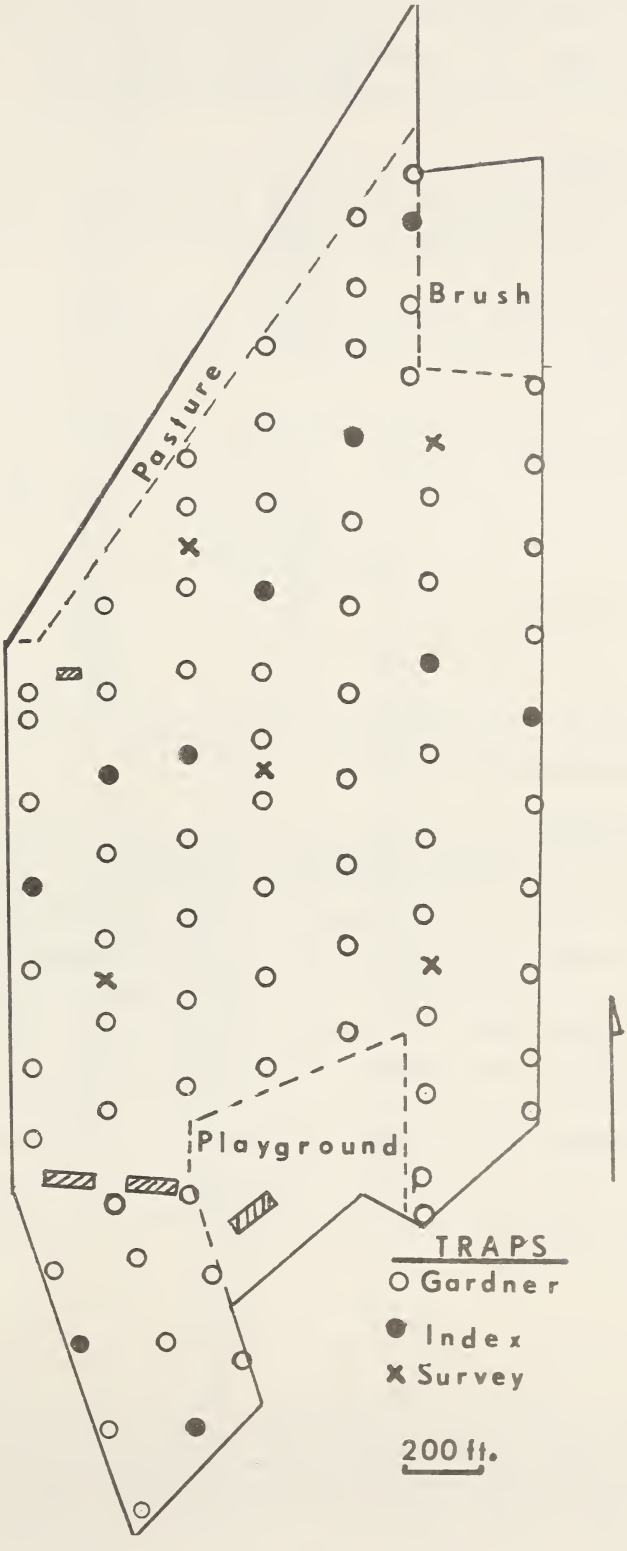

FIGURE 3.—Trap distribution in study field, spring 1966.

TABLE 1.—*Meteorological data for Escuela Granja, 1966 and 1967*

Month	Mean weekly temperature		Rainfall
	Maximum	Minimum	
	° *F.*	° *F.*	*Inches*
1966			
January	74.0	39.8	1.63
February	86.8	42.3	2.55
March	89.3	54.0	2.10
April	97.8	62.2	5.70
May	100.0	67.5	2.50
June	98.5	70.8	5.60
1967			
January	84.0	41.8	1.20
February	89.3	41.0	.52
March	95.0	53.5	0
April	99.8	67.2	0
May	105.5	65.3	.51
June	104.0	73.0	3.90
July	102.6	74.2	1.50
August	101.0	70.0	4.42
September	92.8	68.0	(1)
October 2	87.7	53.3	0

1 Some records lost, but rainfall exceeded 15 inches.

2 Data discontinued Oct. 9.

Starting on March 31, when the first earworm eggs were found, from 16 to 22 20-row-foot samples throughout the field were taken periodically. Twelve of these samples were taken from east to west through the center of the main part of the field to detect any gradient in infestation that might occur from the margins to the center. Corn earworm-infested ears were counted in the study field, a field at the Güémez Ejido, and another field 11 miles southwest of the study field. Samples of eggs and larvae could not be taken from these last two fields because heavy rains made the roads impassable much of the time. Rainfall was relatively abundant during the period of this crop (table 1), and alternate host plants of the corn earworm were common in the area.

Results

Collections in the five survey traps indicated that corn earworm adults were active from the start of the test (table 2). These collections prior to starting the Gardner traps showed an increase beginning the week ending February 16. After the Gardner traps were put in operation on March 3, the total collections increased to a maximum during the week ending April 27. This peak occurred

during maximum tasseling of corn in the field. The number of moths collected declined thereafter, reaching a low point the week ending June 1 when the crop had dried. Another peak occurred the week ending June 15, corresponding to the anticipated emergence of moths developing in the field.

The pattern of collections was similar for both sexes, but the sex ratio fluctuated considerably. It showed a general trend toward a predominance of males during the postsilking period. The females

TABLE 2.—*Estimated corn earworm moths collected weekly in survey and Gardner traps in study field, spring 1966*

Week ending	Moths collected	Sex ratio (♀ : ♂)	Plant condition
	Number		
	SURVEY TRAPS [1]		
Jan. 12	0	----	
19	8	0.6:1	
26	13	1.2:1	
Feb. 2	9	.8:1	
9	11	1.6:1	
16	38	2.5:1	
23	23	.6:1	
Mar. 2	27	.4:1	Emerging.
	GARDNER [2] AND SURVEY TRAPS		
Mar. 9	311	.6:1	
16	1,097	1.3:1	
23	2,289	.9:1	
30	2,665	.8:1	
Apr. 6	1,603	.7:1	
13	2,482	1.4:1	
20	4,658	.8:1	Tasseling.
27	5,084	1.0:1	
May 4	2,610	1.0:1	Silking.
11	3,588	.6:1	
18	3,837	.7:1	
25	717	.7:1	Ears dry.
June 1	276	.7:1	
8	1,062	1.5:1	
15	3,470	.8:1	
22	1,460	.8:1	Harvest.
29	1,327	.6:1	

[1] Collections in five survey traps Jan. 5 to Mar. 2.

[2] Seventy-nine Gardner traps turned on Mar. 3. Moths collected in these traps estimated from collections in 10 Gardner index traps. DDT-methyl parathion dust applied for flea beetles and *Diabrotica* spp.

were most predominant during the start of emergence of the generation produced in the corn.

Collections in the survey traps followed somewhat the same trends as in the Gardner traps. Positional differences were noted among the survey traps (table 3). During the prefruiting period of March 3 to April 13, mean weekly collections were significantly higher in the southwest trap than in the southeast one, but not different from the others. During the fruiting period of April 14 to May 18, collections in the southwest trap were significantly higher than in the other traps, but the latter did not differ among themselves.

Dissections of female corn earworm moths showed that during the fruiting period from April 14 to May 18 about one-third of the females collected were unmated (table 4). Most of these virgins were classed as "immature" since they had large fat bodies and no chorionated eggs in the reproductive system. Based on the estimated number of females trapped during the fruiting period, 2,668 unmated females were removed from the population during this period. The emergence of moths from the brood developing on the corn was obvious from the high proportion of immature virgins dissected during June. The spermatophores per mated female ranged from 1.3 to 1.8 during much of the period, but declined during the emergence of the moths produced in the field.

Infestation samples from the corn are summarized in table 5. Eggs were most abundant in the samples taken on April 27 and May 4. Since most of the eggs found on these dates were deposited on the silks, counting them in the field was difficult; thus, the silks were removed and taken to the Brownsville laboratory for egg counts. In the process some eggs were lost, causing underestimation of the population present. In samples taken on May 19, the ears were opened and examined for larvae and damage. The mean was 8.5 larvae and 15.1 ears per sample, with 54.4 percent of the ears damaged.

The infestation samples taken through the center of the main part of the field from east to west failed to show any distinct gradients for eggs, larvae, or damaged ears (table 6).

A comparison of the damaged ears in the study field and two outlying fields in the same stage of growth (Carlos Dias field at Güémez Ejido and El Olivo field 11 miles southwest) showed no appreciable differences (table 7).

Collections in four outlying survey traps operated one night weekly showed generally lower collections than in the study field (table 8). The pattern of collections in the trap 5 miles northeast was similar to that in the study field.

TABLE 3.—*Comparison of corn earworm moths collected in individual survey traps at 5 locations in study field during 2 periods, spring 1966*

Trap location	Mean moths per week [1]	
	Mar. 3–Apr. 13	Apr. 14–May 18
	Number	*Number*
Southwest	33.7 a	95.2 a
Northwest	17.0 ab	43.0 b
Center	25.5 ab	37.4 b
Southeast	14.3 b	29.6 b
Northeast	30.0 ab	38.0 b

[1] Means within period followed by same letters were not significantly different at 5-percent probability level by Duncan's multiple range test.

TABLE 4.—*Reproductive condition of female corn earworm moths dissected, spring 1966*

Week ending	Moths dissected	Unmated females [1]		Mean spermatophores per—	
		Immature	Total	Female	Mated female
	Number	*Percent*	*Percent*	*Number*	*Number*
Mar. 9 and 16	85	23.5	42.4	0.8	1.4
23	105	19.1	50.5	.7	1.4
30	103	24.3	42.7	.8	1.3
Apr. 6	71	4.2	15.5	1.5	1.8
13	100	12.0	26.0	1.1	1.5
20	105	20.0	24.8	1.0	1.3
27	73	20.5	31.5	.9	1.4
May 4	100	22.0	32.0	1.1	1.7
11	95	26.3	26.3	1.5	2.0
18	52	28.8	36.5	.9	1.6
June 8	64	93.8	95.3	.5	1.0
15	89	79.8	84.3	.2	1.1
29	31	77.4	80.6	.2	1.2

[1] Based on total females dissected.

TABLE 5.—*Corn earworm infestation in study field, spring 1966*

Date	Samples [1]	Mean per sample	
		Eggs	Larvae
	Number	*Number*	*Number*
Mar. 31	22	2.5	0
Apr. 6	16	.2	0
22	16	1.1	0
27	16	[2] 7.5	.1
May 4	16	[2] 7.9	.1
13	16	1.2	1.4
19	16	.2	8.5

[1] 20 row-feet per sample.

[2] Underestimated because of loss of eggs from silks.

TABLE 6.—*Distribution of corn earworm infestation through main part of field, spring 1966*

Area between indicated blacklight-trap lines	Mean per sample [1]		
	Eggs (Apr. 22–May 13)	Mature larvae (May 19)	Damaged ears (May 19)
	Percent	*Percent*	*Percent*
1–2 (west)	22.5	12.4	15.5
2–3	21.7	18.1	17.5
3–4 (center)	20.1	23.8	21.6
4–5 (center)	8.4	19.0	19.6
5–6	20.1	15.2	12.4
6–7 (east)	7.2	11.4	13.4

[1] 248 eggs, 105 mature larvae, and 97 ears observed.

TABLE 7.—*Comparison of corn earworm infestation in study and outlying fields, spring 1966*

Field	Ears examined	Ears per 20 row-feet	Ears damaged
	Number	*Number*	*Percent*
Study	241	15.1	54.4
Carlos Dias	56	11.1	64.2
El Olivo	69	13.8	49.3

TABLE 8.—*Corn earworm moths collected in outlying traps and study field, spring 1966*

Date	Moths collected at indicated location				
	Fodder-sorghum (5 miles NE)	Garden plot (½ mile E)	Pasture (1 mile SW)	Corn (11 miles SW)	Study field
	Number	*Number*	*Number*	*Number*	*Number*
Mar. 2	3	1	0	--	1
9	1	0	0	--	0
16	6	0	2	--	1
24	0	0	0	--	0
Apr. 1	2	1	0	--	3
7	0	0	0	--	2
15	5	1	2	--	0
22	21	4	--	--	53
28	15	2	--	--	2
May 19	0	0	0	0	0
June 3	2	0	0	0	1
10	1	6	0	2	0
15	0	9	2	--	--
24	0	0	0	--	--
30	0	1	2	--	--

1967 Spring Crop

Procedures

The first planting began about March 10 in the southwestern part of the field (planting 1, fig. 4), the second about 10 days later, and the last on March 28. Because of drought conditions (table 1) and a broken irrigation pump, only scattered plants of the last planting reached a fruiting stage. The first and second plantings produced some ears of inferior quality; the first was the best.

The center survey trap (fig. 3) was put in operation on March 9 and discontinued on March 20. The Gardner traps were started on March 21 when corn of the first planting was 6 to 12 inches tall. Four of the Gardner traps were replaced by experimental traps equipped with 40-watt blacklights and 36-inch-diameter funnels (fig. 5) at the locations indicated in figure 4 (*L*). These traps were gravity type equipped with solid-wall collection containers in which calcium cyanide was used as a killing agent. Collections of insects from these and 24 Gardner index traps were made daily. The index traps were situated in four concentric perimeters of decreasing radius from the center of the field. The number of traps in each perimeter was as follows:

Traps	*Perimeter*			
	Outer	*Second*	*Third*	*Center*
Gardner	31	8	7	1
Gardner index	9	7	5	3
Large	3	1	0	0
Total	43	16	12	4

Five 20-row-foot samples were taken weekly for eggs, larvae, and larval exit holes in the corn ears in the first planting area of the field starting on April 27 when the first tassels were found and continued until June 2 when the ears had dried. Thirty-three samples were taken weekly from the second planting area from May 4 to June 2. Eleven of these samples were taken on an east-west line through the center of the second planting to detect any gradients in infestation. Three-power magnifying loupes were used to count eggs and small larvae. The last planting was not sampled because of its poor condition.

Results

Collections of corn earworm adults (table 9) were considerably below those of the 1966 spring crop during the fruiting of the first and second plantings from April 20 to May 21. Collections increased rapidly the week ending June 6 and remained relatively large for

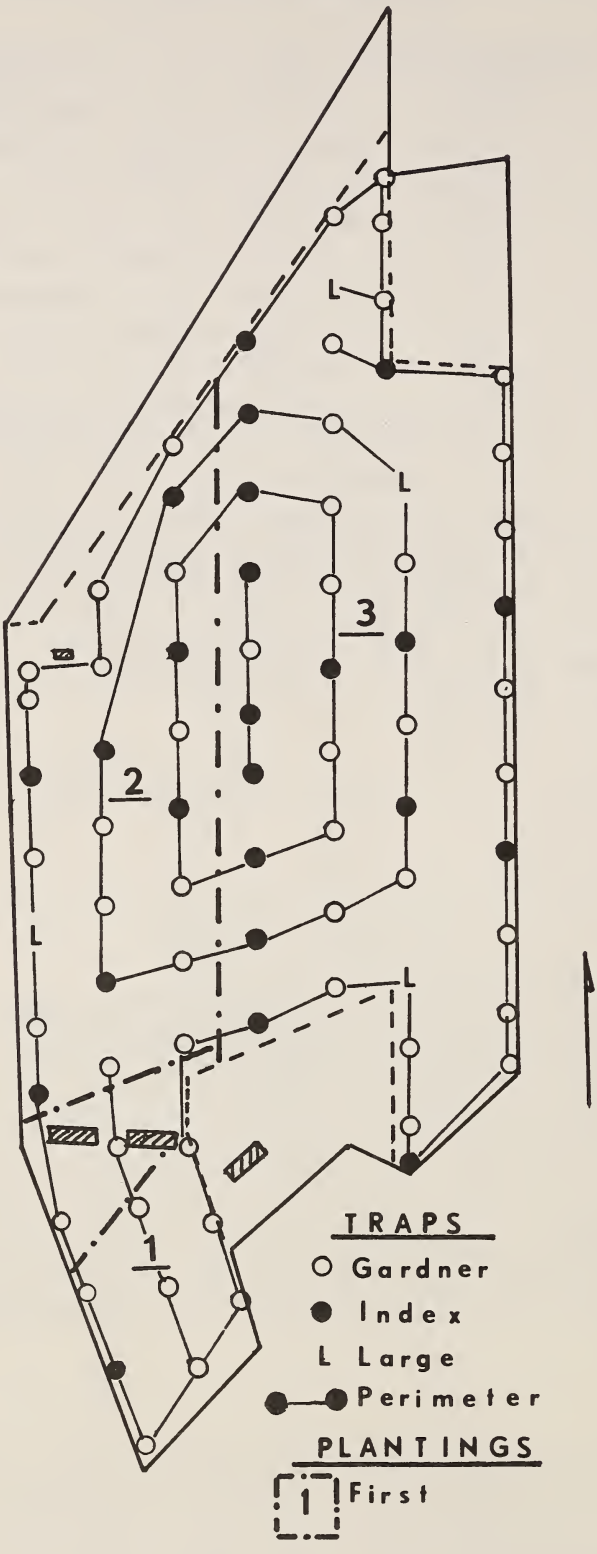

FIGURE 4.—Trap distribution in study field, spring 1967.

3 weeks. This sharp increase coincides with a 2.40-inch rainfall on June 2 and 3. The first and second plantings had dried at this time and were unsuitable for reproduction of the insects, but some plants of the third planting revived after the rain and produced some ears, which were heavily infested by the corn earworm. Collection patterns of males and females were similar. Sex ratios showed collections of males were slightly larger than those of females during the fruiting period of the first and second plantings. The ratio was near unity during the June population increase.

Collections in the four perimeters of traps through June 30 showed both males and females were lowest in the outer ring of traps; those in the remaining three rings were similar (table 10). Since corn in the eastern half of the field (third planting) was in poor condition, a similar comparison was made in the area of the second planting to

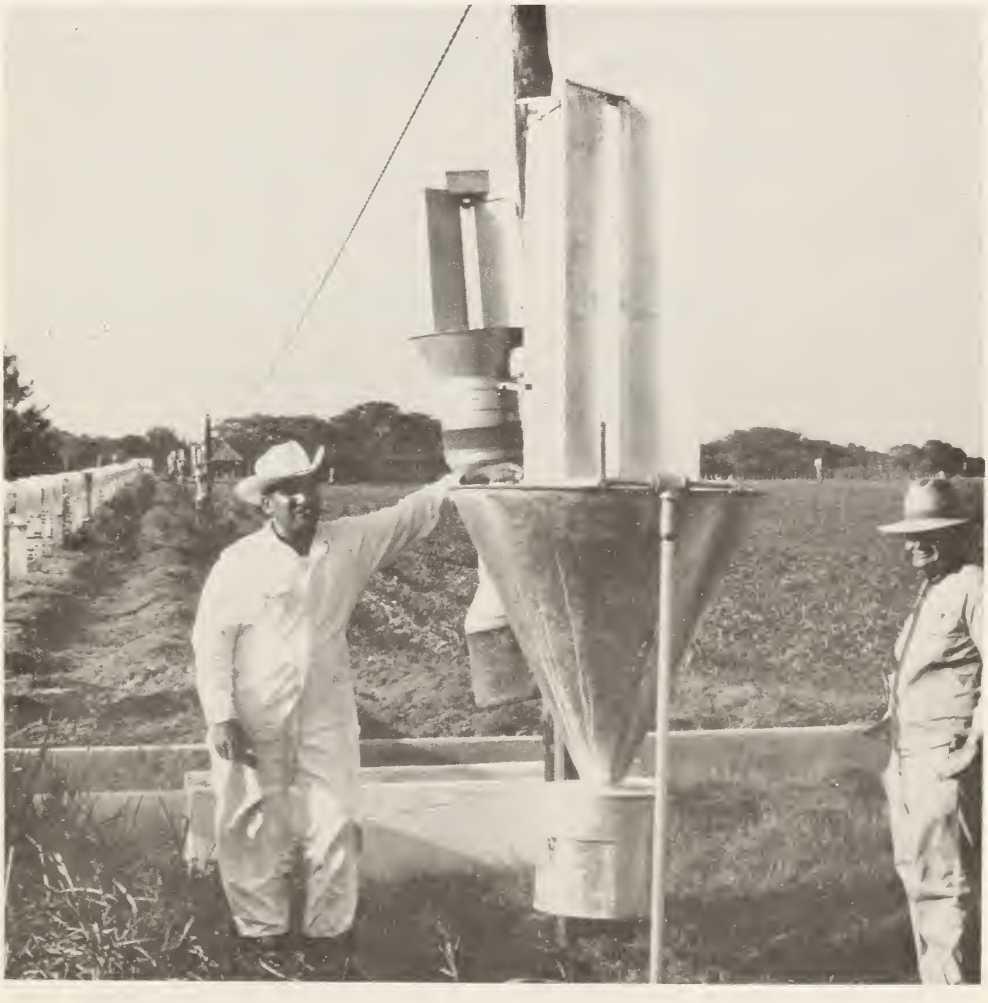

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FIGURE 5.—40-watt blacklight trap.

eliminate any possible effects of the third planting on moth distribution. The collections per trap in five Gardner and one large trap around the periphery of the second planting were compared with those in the two Gardner traps in the center (table 10). Results were similar to the comparison for the entire field.

Mating of females collected in the traps was below that of the 1966 level with a corresponding increase in the proportion of unmated females (table 11). The proportion of unmated females dropped when the upsurge in collections occurred in June and increased again in July and early August. Most of the unmated females were classed as immature. The number of spermatophores per mated female was generally in the same range as during the 1966 spring crop.

Infestation samples showed eggs were most abundant on May 4 and larvae started to leave the ears to pupate on May 17 (table 12). The egg and larval population estimates on the first and second plantings were lower than on the 1966 crop. The overall mean of

TABLE 9.—*Estimated corn earworm moths collected weekly in all traps in study field, spring 1967*

Week ending	Moths collected [1]	Sex ratio (♀ : ♂)	Plant condition
	Number		
Mar. 28	98	1.0:1	
Apr. 4	630	.9:1	
11	661	.9:1	
18	1,356	.7:1	
25	247	.3:1	1st–2d planting—tasseling.
May 2	491	.7:1	1st–2d planting—silking.
9	1,699	.5:1	
16	363	.7:1	
23	295	.7:1	
30	895	.9:1	1st–2d planting—ears dry.
June 6	10,317	1.0:1	3d planting—silking.
13	4,739	1.1:1	
20	4,222	.7:1	1st–2d planting—harvested.
27	601	.7:1	
July 4	1,048	1.0:1	
11	750	1.2:1	
18	619	.6:1	
25	33	.7:1	
Aug. 1	7	.0:1	

[1] Estimated number per 75 Gardner traps, based on 24 index traps, and 4 large traps through June 30; number per 79 Gardner traps, based on 12 index traps, thereafter.

damaged ears per sample was 1.0 (16.1 percent) in the first planting and 1.2 (23.9 percent) in the second. The series of 11 samples taken on an east-west line through the center of the second planting failed to yield sufficient information to detect any gradients that might have existed from the periphery to the center.

Three 20-row-foot samples taken on June 1 in a field at the Güémez Ejido, which was in a comparable condition to the study field, showed a mean of 9.3 ears per sample, with 2.7 per sample (29 percent) damaged by the corn earworm.

TABLE 10.—*Distribution of corn earworm moths collected in entire field and in second crop area, spring 1967*

Trap location [1]	Mean moths per trap	
	Males	Females
	Number	*Number*
Entire field, perimeters:		
Outer	100.9	81.9
Second	207.3	184.3
Third	200.4	173.0
Center	203.7	202.0
Second crop area:		
Outside	231.0	192.0
Inside	326.0	252.0

[1] In outer and second perimeters and in outside area large traps included.

TABLE 11.—*Reproductive condition of female corn earworm moths dissected, spring 1967*

Period	Moths dissected	Unmated females [1]		Mean spermatophores per—	
		Immature	Total	Female	Mated female
	Number	*Percent*	*Percent*	*Number*	*Number*
Mar. 22–30	17	23.5	23.5	1.1	1.4
Apr. 6–13	56	21.4	26.8	.9	1.2
14–19	56	30.4	37.5	.8	1.2
20–27	30	46.6	53.3	.8	1.6
Apr. 28–May 5	56	71.4	75.0	.4	1.4
6–11	56	39.3	41.1	.9	1.6
12–18	50	70.0	72.0	.5	1.8
19–25	40	65.0	67.5	.4	1.1
May 26–June 2	53	75.5	79.2	.3	1.3
3–9	52	34.6	34.6	1.0	1.4
10–15	56	35.7	37.5	.8	1.3
16–23	51	54.9	58.8	.7	1.6
24–30	51	41.2	45.1	.8	1.5
July 1–7	68	85.3	85.3	.2	1.1
8–21	51	86.3	88.2	.1	1.2
July 22–Aug. 6	34	73.5	79.4	.2	1.1

[1] Based on total females dissected.

A comparison of collections in the 40-watt traps and adjacent Gardner traps showed the larger traps were superior, based on the number of corn earworm moths collected and the total weight of collections (table 13).

TABLE 12.—*Corn earworm infestation in study field, spring 1967*

Date	Plantings [1]	Samples [2]	Mean per sample		
			Eggs	Larvae	Exit holes
	Number	*Number*	*Number*	*Number*	*Number*
Apr. 27	1	5	0.2	0.2	0
May 4	1	5	1.2	.2	0
	2	33	3.5	.1	0
	Combined	38	3.2	.1	0
May 10	1	5	0	.8	0
	2	33	.3	.2	0
	Combined	38	.2	.3	0
May 17	1	5	.2	1.0	.6
	2	33	.4	1.1	0
	Combined	38	.4	1.1	.1
May 25	1	5	0	0	1.0
	2	33	.1	.4	.6
	Combined	38	.1	.4	.7
June 2	2	33	0	.1	.9

[1] Combined refers to mean number of eggs, larvae, and exit holes found in total samples taken on respective dates.

[2] 20 row-feet per sample.

TABLE 13.—*Comparison of corn earworm moths collected in 40-watt and adjacent Gardner traps, spring 1967*

Trap	Mean moths per trap			Mean weight of total collections per trap
	Males	Females	Total	
	Number	*Number*	*Number*	*Grams*
40-watt	289.3	397.5	686.8	7,369.7
Gardner	129.3	116.7	246.0	1,430.4

1967 Fall Crop

Procedures

In the fall of 1967 approximately one-third of the field was planted to beans, one-fourth to a mixture of corn and beans, and the rest to corn (fig. 6). Five plantings of the corn crop were made—July 11, 19, 25, August 3, and 10.

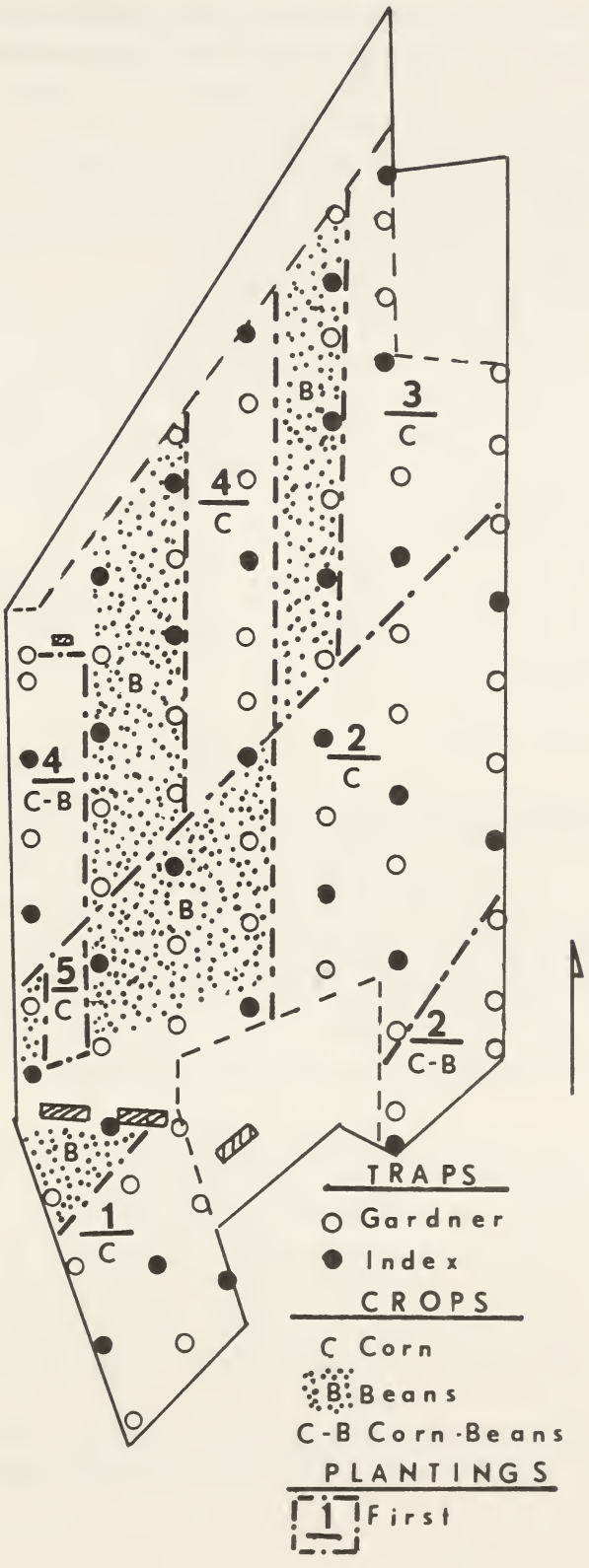

FIGURE 6.—Trap distribution in study field, fall 1967.

The Gardner traps were operated continuously after the spring crop. Collections were made from July 1 to August 16 from 12 Gardner index traps, which were then increased to 30 (fig. 6). Rainfall was rather abundant during production of this crop (table 1), and wet collections with numerous beetles in them resulted. To provide collections in better condition, the insects were dried in trays with ¼-inch mesh hardware cloth on the bottom. All macrolepidoptera were removed and saved for examination.

Collections from several traps were discarded by school personnel from August 31 to September 13 under the erroneous assumption that they contained only beetles. Collections were made erratically from September 14 to October 4 and were in poor condition because of Hurricane Beulah, which made it difficult at times to service the traps and impossible for personnel of the Brownsville laboratory to reach the study site until October 9.

Eggs, larvae, larval exit holes, total ears, and infested ears were sampled in the various plantings. The samples ranged from eight in the first planting to a maximum of 26 in the second.

Results

Estimated numbers of corn earworm adults collected during this crop were below those of the two preceding crops (table 14). This estimate was in error because of the loss or poor condition of some collections during September. Maximum numbers of males and females were collected the week ending September 20, which preceded Hurricane Beulah. Rainfall records for this period were lost, but it was recalled that 15 to 20 inches of rain fell from September 14 to 27. Sex ratios indicated males predominated during most of the fall crop.

Dissections of females indicated a high percentage of those collected during September were mated; however, thereafter most were unmated (table 15). As with the spring crop, most of the virgins were immature. Increased proportions of unmated females during October and November coincided with the anticipated emergence of moths from the various corn plantings. The number of spermatophores per mated female was slightly higher than during the spring crop.

The seasonal mean number of moths collected per trap was highest in the first, second, and third plantings, although the chronological

pattern of collections in the first was slightly different from that in the latter two (table 16). Collections per trap were lowest in the fourth planting.

TABLE 14.—*Estimated corn earworm moths collected weekly in 79 Gardner traps in study field, fall 1967*

Week ending [1]	Moths collected	Sex ratio (♀ : ♂)	Plant condition
	Number		
Aug. 8	66	0.7 :1	
15	546	.7 :1	
23	139	.4 :1	
30	5	.0 :1	1st planting—tasseling.
Sept. 6	32	.3 :1	1st planting—silking.
13	108	.8 :1	2d–3d planting—tasseling.
20	371	.4 :1	
27	84	.5 :1	
Oct. 4	134	1.2 :1	
11	192	.9 :1	2d–3d–4th planting—silking; 1st planting—harvested.
18	124	.7 :1	5th planting—silking.
25	134	.9 :1	2d–3d planting—ears dry.
Nov. 1	69	.7 :1	
8	29	.4 :1	4th–5th planting—ears dry.
15	11	.3 :1	
22	3	1.0 :0	
29	8	.6 :1	
Dec. 6	6	1.0 :1	

[1] Index traps increased from 12 to 30 at end of Aug. 15 week. Estimates in error because of loss or poor condition of some collections during September.

TABLE 15.—*Reproductive condition of female corn earworm moths dissected, fall 1967*

Period	Moths dissected	Unmated females [1]		Mean spermatophores per—	
		Immature	Total	Female	Mated female
	Number	*Percent*	*Percent*	*Number*	*Number*
Sept. 8–14	25	8.0	8.0	1.5	1.6
Sept. 15–Oct. 3	50	20.0	20.0	1.5	2.0
Oct. 4–10	23	69.6	78.3	.3	1.4
11–18	22	72.7	77.3	.3	1.4
19–25	19	47.4	52.6	1.0	2.1
Oct. 26–Nov. 1	11	63.6	63.6	.5	1.3

[1] Based on total females dissected.

TABLE 16.—*Distribution of corn earworm moths collected in various plantings, fall 1967*

Week ending	Mean moths per trap in indicated plantings						
	1	2	3	4			5
				East	West	Entire planting	
	Number	*Number*	*Number*	*Number*	*Number*	*Number*	*Number*
Aug. 23	1.00	1.90	2.33	1.40	1.75	1.56	1.00
30	0	0	0	0	.50	.22	0
Sept. 6	.75	1.00	.33	0	0	0	0
13	1.00	2.50	1.50	1.20	.25	.78	.50
20	2.00	8.30	6.33	3.20	3.75	3.44	2.50
27	.75	1.40	.50	.60	.50	.56	1.00
Oct. 4	3.25	1.10	1.00	1.20	2.25	1.67	1.50
11	2.75	2.00	3.33	2.20	1.75	2.00	3.50
18	.50	1.60	2.00	1.80	2.00	1.89	2.00
25	3.50	1.80	2.00	1.40	1.00	1.22	2.50
Nov. 1	1.25	1.10	1.10	.60	.25	.44	2.50
8	.50	.30	0	1.00	.50	.78	0
15	0	.10	0	0	.75	.33	0
22	0	.10	0	.20	0	.11	0
29	1.00	0	0	0	0	0	0
Dec. 6	0	.10	0	0	0	0	.50
Total	18.25	23.30	20.42	14.80	15.25	15.00	17.50

Larval infestations followed a similar pattern for each planting (table 17). Mean number of larvae per sample in the plantings was as follows:

Plantings	*Larvae per sample (number)*
1	3.2
2	3.6
3	3.1
4	2.0
5	1.2

The first larval exit holes were found in ears of the first planting on October 2, but probably some were present earlier, based on the rate of larval development and the number found in this sample. First exit holes were found in the second planting on this date also.

In the third, fourth, and fifth plantings they were found on October 8, October 17, and November 1, respectively.

TABLE 17.— *Corn earworm infestation in study field, fall 1967*

Date	Plantings [1]	Samples [2]	Mean per sample		
			Eggs	Larvae	Exit holes
	Number	*Number*	*Number*	*Number*	*Number*
Aug. 30	1	14	0.42	0	0
Sept. 8	1	16	.87	.87	0
Sept. 13	1	8	.37	2.75	0
	2	26	5.38	0	0
	3	6	.16	0	0
	Combined	40	3.60	.55	0
Oct. 2	1	8	0	9.00	2.25
	2	18	.61	8.77	.22
	3	9	.56	6.89	0
	4	9	.67	1.11	0
	Combined	44	.50	6.86	.50
Oct. 8	1	8	0	2.25	3.12
	2	12	.08	4.75	.25
	3	9	0	6.33	.22
	4	7	.14	5.28	0
	5	2	.50	0	0
	Combined	38	.70	4.45	.79
Oct. 17	1	8	0	1.12	4.75
	2	13	0	6.53	2.30
	3	9	0	4.22	1.33
	4	9	0	3.89	.11
	5	2	0	0	0
	Combined	41	0	4.07	1.98
Oct. 25	2	12	0	.58	2.33
	3	9	0	2.00	2.44
	4	9	.11	2.77	1.44
	5	4	2.25	1.00	0
	Combined	34	.29	1.59	1.85
Nov. 1	2	12	0	.50	3.91
	3	9	0	.44	3.56
	4	9	0	.79	2.78
	5	4	0	1.00	.25
	Combined	34	0	.62	3.09

See footnotes at end of table.

TABLE 17.—*Corn earworm infestation in study field, fall 1967*—Con.

Nov. 8	2	12	0	.33	3.67
	3	9	0	0	2.67
	4	9	0	.22	4.56
	5	4	0	3.00	.50
	Combined	34	0	.62	3.27
Nov. 15	4	9	0	.11	3.22
	5	4	0	1.75	.50
	Combined	13	0	.62	2.38
Nov. 21	5	4	0	1.50	1.75

[1] Combined refers to mean number of eggs, larvae, and exit holes found in total samples taken on respective dates.

[2] 20 row-feet per sample.

Damage counts made after the silks of each planting had dried showed a similar number per sample and percent of damaged ears in the various plantings (table 18).

TABLE 18.—*Corn earworm damage to corn in study field, fall 1967*

Plantings	Date examined	Samples [1]	Mean ears per sample		Ears damaged
			Total	Damaged	
		Number	*Number*	*Number*	*Percent*
1	Oct. 17	8	17.00	6.50	38.2
2	Nov. 1	12	16.00	4.42	27.6
3	do	9	13.67	3.89	28.4
4	Nov. 8	9	14.00	4.56	32.6
5	Nov. 21	4	11.00	3.25	29.5

[1] 20 row-feet per sample.

Examination of the beans in the study field on several occasions showed no infestation by the corn earworm.

Discussion

The results of this study indicate that large numbers of corn earworm moths were collected from a rather dense blacklight trap installation and at times a considerable number of these were immature virgins. However, we do not know what percentage of such a population was removed.

Since no crop was planted in the field preceding the 1966 spring crop and host plants in the field were very scarce, we can assume

that moths infesting this crop probably came from outside the field. Likewise, since the crop planted in the fall of 1966 did not reach a stage that could support the corn earworm, we can assume that most of the moths in the spring of 1967 came from outside sources. Using these assumptions and considering the patterns of infestation and collections during the springs of 1966 and 1967, it appears that our trap installation did not prevent moths from covering the field rather uniformly. Also, infestations in the study field were similar to those in some outlying fields during these periods.

In the fall of 1967 when a series of staggered planting dates was used, the last two plantings showed slightly lower corn earworm moth collections per trap and larval populations per sample than the three earlier ones, but the number per sample and the percent of damaged ears were similar for all plantings. This could indicate that the traps provided some protection for the late plantings from moths emerging from the earlier ones, but at this time temperatures were becoming cooler and thus slowed moth activity. Also, probably a high proportion of the pupae developing on the crop after mid-September entered diapause and reduced moth emergence from the earlier plantings.

The seasonal mating patterns were variable in the study. The records for the spring of 1966 and fall of 1967 indicate that the emergence of a brood of moths in the field produced a high proportion of immature virgins in the traps. The fact that this proportion was maintained for several weeks suggests that either most females were caught as they emerged or they left the field shortly after emerging from pupae because of a lack of suitable host plants.

The data suggest that such an installation of blacklight traps is not useful for protecting an individual cornfield from damage by the corn earworm. However, it is possible that an installation of traps over a large area could have an impact on the total corn earworm population if the density of traps was sufficiently high.

Summary

Blacklight traps were installed in a semi-isolated 49-acre cornfield at a density of about 1.6 traps per acre to determine whether such an arrangement could provide adequate protection of the crop from damage by the corn earworm (*Heliothis zea* (Boddie)). The results of operating the traps over a 2-year period, including three crops of corn, indicated this method did not prevent corn earworm moths from outside sources from dispersing throughout the field nor did it protect the crop from damage by the pests.

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